17. (New) The capping apparatus of Claim 16, wherein the elevating mechanism ceases the descent of the capping head at an elevation where the clamping of the cap onto the vessel is to be initiated.

18. (New) The capping apparatus of Claim 16, wherein the elevating mechanism and the control means are arranged so that the cap is rotated in the clamping direction during its descent at such a speed that the cap rotates through at least one revolution while it descends by a vertical distance corresponding to the width of one of the threads on the vessel.

a13

19. (New) The capping apparatus of Claim 16, wherein the control means measures a rotational load acting on the cap as the acting force.

20. (New) The capping apparatus of Claim 16, wherein the control means measures a vertical load acting on the cap as the acting force.

REMARKS

The abstract and specification have been amended in order to correct grammatical and idiomatic errors contained therein. No new matter has been added.

In order to expedite the prosecution of the present application and respond to the Examiner's rejection of the claims under 35 USC 112, Claims 1-9 have been canceled and replaced by newly presented Claims 10-20 which more particularly point out and distinctly claim the subject matter which Applicant regards as the invention. No new matter has been added.

Claims 1-9 have been rejected under 35 USC 112, second paragraph, as being indefinite. The language objected to in

Claims 1-9 is not contained in newly presented Claims 10-20. Accordingly, this rejection is no longer applicable.

Claims 1-9 have been rejected under 35 USC 102(b) as being anticipated by Spatz et al. Applicant respectfully traverses this ground of rejection and urges reconsideration in light of the following comments.

One aspect of the present invention is directed to a method of clamping a cap onto a vessel which comprises the steps of providing a cap having threads, a vessel having threads with a predetermined winding angle adapted to engage with the threads of the cap, a capping head holding the cap and a motor for rotating the capping head in the clamping direction, measuring a change in a force acting on the cap as distal ends of the threads on the cap and the vessel contact each other during relative rotation of both threads, and detecting an incipient position of a meshing engagement where the distal ends of both threads first contact each other on the basis of the change in the acting force.

Another aspect of the present invention is directed to a capping apparatus for clamping a cap onto a vessel. The apparatus comprising a capping head for holding a cap having threads, a motor for rotating the capping head in a clamping direction for the cap to be clamped onto a vessel having threads with a predetermined winding angle adapted to engage with the threads of the cap, an elevating mechanism for raising the capping head up and down, measuring means for measuring a change in a force acting on the cap which is held by the capping head, angle detecting means for detecting an angular position to which the capping head is rotated and control means for causing the capping head to rotate forwardly or reversely with respect to the clamping direction during the course of the descent of the capping head to an elevation where a clamping of the cap is to be initiated, measuring a change in a force acting on the cap as distal ends of the threads on the cap and the vessel contact each other during

relative rotation of both threads and detecting an incipient position of a meshing engagement where the distal ends of both threads first contact each other on the basis of the change in the acting force.

In the present invention, the precise incipient position of the meshing engagement where the distal ends of the threads of the cap and the threads of the vessel first contact each other can be detected independent of the influence of temperature or humidity. Additionally, the present invention allows for the cap to be attached to the vessel based on the incipient position of the meshing engagement so that the tightness of the cap can be constant after it is attached to the vessel since the cap is turned through a given angle of rotation based on the initial contact position. This allows a uniform clamping of caps to the vessels. It is respectfully submitted that the prior art cited by the Examiner does not disclose the presently claimed invention.

The Spatz et al reference discloses a slewing device for screw closures for containers. This device comprises a screw closure receiving member, a drive for rotating the receiving member, and a control arrangement for controlling power supplied to the drive and including a torque sensor for sensing an instantaneous drive torque, a comparator for comparing the instantaneous drive torque with a closing torque having a predetermined value, and a sensor for sensing an angle of rotation of the receiving member and actuatable only upon the instantaneous drive torque reaching the predetermined value. In this reference, a screw closure is screwed down until it reaches a predetermined closing moment and, thereafter, an angle of rotation and/or a chronological change is determined. That is, a defined initial state of the closure process in which the cap or closure as threaded onto the container is reached and after this, the closure or cap is turned through a predetermined angle of rotation relative to the container to achieve the desired closure.

The presently claimed invention is expressly different from Spatz et al since the present invention requires the detecting of a position where the distal ends of the threads on a cap and a vessel first contact with each other and then the cap is finally tightened onto the vessel. Spatz doesn't initiate the final tightening of the cap until a predetermined torque is reached after the cap is initially screwed onto the vessel. The Spatz et al arrangement has a problem in that a liquid adhering to a mouth of a vessel when the temperature or humidity changes or the vessel is filled can alter the frictional characteristics of the threaded neck of the vessel so that the measured torque and initial screwing on of the cap can vary along the length of the neck of the vessel. Therefore, even when the cap is further rotated at the predetermined angle from the rotated position at the moment M1 to be attached to the vessel, constant tightness of the cap may not be obtained at the capping, which defeats the object of Spatz et al. The present invention avoids these problems by determining the initial position at which the threads of the cap and the vessel contact each other and commencing the final tightening operation from that point. Additionally, Claims 15 and 20 require the measurement of a vertical load acting on the cap as the acting force. Spatz et al has no disclosure with respect to this type of measurement being made. Therefore, these claims are even further distinguishable over Spatz et al.

The Examiner is respectfully requested to reconsider the present application and to pass it to issue.

Respectfully submitted,

Terrence F. Chapman

TFC/smd

FLYNN, THIEL, BOUTELL
& TANIS, P.C.
2026 Rambling Road
Kalamazoo, MI 49008-1699
Phone: (269) 381-1156
Fax: (269) 381-5465

Dale H. Thiel	Reg. No. 24 323
David G. Boutell	Reg. No. 25 072
Ronald J. Tanis	Reg. No. 22 724
Terryence F. Chapman	Reg. No. 32 549
Mark L. Maki	Reg. No. 36 589
David S. Goldenberg	Reg. No. 31 257
Sidney B. Williams, Jr.	Reg. No. 24 949
Liane L. Churney	Reg. No. 40 694
Brian R. Tumm	Reg. No. 36 328
Tricia R. Cobb	Reg. No. 44 621

Encl: Marked-Up Abstract and Specification Amendments
Substitute Abstract
Postal Card

136.0112

IN THE ABSTRACT

Please amend the abstract as follows and replace it with the new Abstract enclosed herewith.

CAPPING METHOD AND APPARATUS

~~Abstract of the Disclosure~~

ABSTRACT OF THE DISCLOSURE

A capping apparatus 1 includes torque ~~measuring means~~sensor 12 which detects an output torque when a chuck 7 is driven for rotation by a motor 9. Initially, a cap 5 is held by the chuck 7. The cap 5 is fitted over a mouth of a vessel 2, and then the chuck 7 is rotated through one revolution in a clamping direction. A resulting output torque is detected by the torque ~~measuring means~~sensor 12, and the output torque rapidly increases at the position where the threads on the cap 5 and the vessel 2 abut against each other (an incipient position of meshing engagement P). The cap 5 is rotated through a given angle of rotation as referenced to the incipient position of meshing engagement P, thus threadably engaging the cap 5 with the vessel 2. The invention allows a uniform clamping of cap 5 at the completion of the capping operation.

RECEIVED
NOV - 1 2002
TECHNOLOGY CENTER R3700

IN THE SPECIFICATION

Please amend the specification as follows.

Please replace the paragraph beginning on page 2, line 2, and ending on page 2, line 7, with the following rewritten paragraph:

According to the conventional method, the incipient position of a meshing engagement between ~~the~~both threads is determined on the basis of the magnitude of descent of the cap, and this, disadvantageously, requires the provision of means for detecting the descent ~~disadvantageously~~. Such detecting means would include a vertically slidable component, which undergoes an abrasion, thus presenting a problem in respect of ~~the~~durability.

Please replace the paragraphs beginning on page 2, line 20, and ending on page 2, line 25, with the following rewritten paragraphs:

measuring a change in a force acting on the cap as distal ends of threads on the cap and the vessel contact each other during the relative rotation of ~~the~~both threads;

and detecting an incipient position of a meshing engagement where the distal ends of ~~the~~both threads contact on the basis of the change in the acting force.

Please replace the paragraphs beginning on page 3, line 12, and ending on page 3, line 22, with the following rewritten paragraphs:

and control means for controlling the rotation of the motor in response to a result of a measurement from the measuring means and an angle signal from the angle detecting means;

the control means being arranged such that in the course of a descent of the capping head to an elevation where a clamping of the cap is to be initiated, it causes the capping head to rotate either forwardly or reversely with respect to the clamping direction to cause distal ends of both threads on the cap and the vessel to contact each other, the control means detecting an incipient position of a meshing engagement between ~~the~~both threads where their distal ends contact each other on the basis of a change in the force acting on the cap.

Please replace the paragraph beginning on page 4, line 24, and ending on page 4, line 25, with the following rewritten paragraph:

Fig. 9 is an illustration of a cap 5 before it is threadably engaged with a vessel 2 according to a third ~~invention~~embodiment of the invention;

Please replace the paragraph beginning on page 5, line 13, and ending on page 5, line 14, with the following rewritten paragraph:

Fig. 15 is a front view of the essential parts of ~~still~~a fifth embodiment of the invention; and

Please replace the paragraphs beginning on page 6, line 7, and ending on page 6, line 22, with the following rewritten paragraphs:

The capping head 6 includes a chuck 7, which is known in itself, for detachably holding the cap 5 under pneumatic pressure, and a pair of upper and lower splined shafts 8a, 8b which are coupled to the chuck 7. The splined shafts 8a, 8b are mechanically coupled to a motor 9, the operation of which is in turn controlled by a controller 11. Thus, when the motor 9 is set in motion to rotate the splined shafts 8a, 8b and the chuck 7 in a direction to clamp the cap, the cap 5, which is held by the chuck 7, is threadably engaged around the mouth of the vessel 2.

Torque measuring means 12, which measures a force acting upon the cap 5 held by the capping head 6 as a rotational load, and an encoder 13, acting as angle detecting means, are connected to the motor 9. In this manner, when the motor 9 is set in motion, an output torque from the motor 9 is detected by the torque measuring means 12, with a result of measurement being fed to the controller 11. At the same time, an angular position of rotation of the motor 9 is detected by the encoder 13, which feeds an angle signal to the controller 11.

Please replace the paragraph beginning on page 8, line 6, and ending on page 8, line 13, with the following rewritten paragraph:

Specifically, referring to Fig. 3, the cam surface of the elevating cam is formed with a descent stop zone A toward the left end, as viewed in Fig. 3, where the capping head 6 ceases to descend and maintains ~~a~~the same elevation while it~~s~~ travels. The descent stop interval A is provided in the course of a descent of the capping head 6 to the elevation of the clamping zone B at a location where the cap 5 is fitted over the vessel 2, but before the female threads 5a on the cap 5 are urged against the male threads 2a on the vessel 2 by the spring 14.

Please replace the paragraphs beginning on page 9, line 1, and ending on page 10, line 4, with the following rewritten paragraphs:

In the present embodiment, while the capping head 6 ceases its descent in the descent stop zone A, the torque measuring means 12 detects an output torque from the motor 9 while the controller 11 causes the motor 9 to rotate through one revolution in either a forward or reverse direction, thus causing the cap 5 held by the chuck 7 on the capping head 6 to rotate through one revolution either forwardly or reversely.

When the cap 5 is rotated through one revolution, it follows that the lower end 5a- of the female threads 5a on the cap 5 once abuts against the upper end 2a- of the male threads 2a on the vessel 2 during such rotation, and at the instant of abutment, an output torque or a rotational load which has a maximum magnitude during the one revolution rotation of the cap 5 is measured. When a result of this measurement is input to the controller 11, the latter recognizes a prevailing angular position ~~of~~by

means of the encoder 13. Fig. 4 shows a relationship between the output torque detected by the torque measuring means 12 with respect to the angular position of rotation of the motor 9 or the angular position of rotation of the cap 5 and the capping head 6 detected by the encoder 13 during the time the motor 5 causes the cap 5 to rotate through one revolution in the clamping direction. When the lower end 5a- of the female threads 5a on the cap 5 abuts against the upper end 2a- of the female threads 2a on the vessel 2, there occurs a rapid increase in the output torque as indicated by a peak in Fig. 4. This position represents the incipient position P of meshing engagement. It is to be noted that the torque measuring means 12 is designed to measure the magnitude of the current which is supplied to the motor 9. Thus, the magnitude of the current supplied to the motor 9 increases when there is a rotational load. This is indirectly determined as a change in the output torque, and the incipient position of meshing engagement P is detected as an angular position of rotation where the magnitude is equal to or greater than a given value.

Please replace the paragraphs beginning on page 11, line 25, and ending on page 12, line 16, with the following rewritten paragraphs:

It is to be understood that the incipient position of meshing engagement P merely represents a reference position, and if the configuration of the threads on the vessel and/or cap is modified, such position moves back and forth. To achieve a required winding angle, an optimum winding angle, which is referenced to the incipient position of meshing engagement which is

determined for a particular combination of a vessel and a cap which are to be capped together, is previously determined, and is chosen as a given angle θ 2.

Thus it will be seen that in the present embodiment, the incipient position of meshing engagement P is detected in terms of a change in an output torque from the torque measuring means 12, and the cap 5 is rotated through the given ~~angel~~angle of rotation θ 2 as referenced to the incipient position of meshing engagement P thus determined, thus causing it to be threadably engaged with the vessel 2. This allows the incipient position of meshing engagement P to be detected accurately, and a subsequent clamping operation takes place always uniformly as the cap 5 is capped to assure a capping operation of a high precision.

Please replace the paragraphs beginning on page 15, line 21, and ending on page 16, line 11, with the following rewritten paragraphs:

At this time, a rotational speed of the motor 9 is chosen to be such that the cap rotates at least through one revolution during the time the cap 5 descends in the vertical direction by an amount corresponding to the width of a single one of the male threads 2a on the cap 2 under the influence of the elevating cam. The rotational speed of the motor 9 in the rapid rotation zone A is higher than the rotational speed which is used during the capping operation (the speed with which the capping head 6 is caused to descend under the influence of the elevating cam is greater than the speed with which the cap 5 descends while rotating in order to prevent~~s~~ the

vessel 2 from being lifted up at the commencement of the clamping operation).

As a consequence, it is assured that the lower extremity 5a- of the female threads 5a on the cap 5 abuts against the top end 2a- of the male threads 2a on the vessel 2 during the rotation through one revolution, as indicated in Fig. 9, whereby an increase in the output torque is detected by the torque measuring means 12 (see P in Fig. 11). The position P represents a position where the meshing engagement is initiated.

Please replace the paragraph beginning on page 16, line 17, and ending on page 17, line 2, with the following rewritten paragraph:

The rotation of the cap 5 is ceased for the following reason: in this embodiment, depending on the elevation of the cap 5 when it abuts against the male threads 2a on the vessel 2, it is uncertain whether the female threads 5a on the cap 5 are located on the upside or downside of the male threads 2a on the vessel 2 for threadable engagement. If the female threads 5a on the cap 5 are located on the underside of the male threads 2 on the vessel 2 to proceed into the threadable engagement, the capping head 6 is not yet descended enough, whereby the vessel 2 may be lifted up. However, because the capping head 6 continues to descend to be situated in the clamping zone B, the female threads 5a on the cap 5 can be urged against the ~~fe~~male threads 2a on the vessel 2.

Please replace the paragraphs beginning on page 18, line 20, and ending on page 19, line 4, with the

following rewritten paragraphs:

When the cap 5 is rotated in the descent deceleration zone A, it is assured that the lowest extremity on the cap 5 abuts against the top end 2a- of the male threads 2a on the vessel 2, allowing an increase in the output to be detected upon abutment (see P in Fig. 14). This defines the incipient position of meshing engagement P.

When the controller 11 detects the abutment of the lowest extremity 5a- of the female threads 5a on the cap 5 against the top end 2a- of the male threads 2a on the vessel 2 in terms of the increase in the output torque, it increases the descending speed of the capping head 6 until it descends to the clamping zone B, thus urging the female threads 5a on the cap 5 against the male threads 2a on the vessel 2. The descending speed of the capping head 6 is increased in order to prevent the vessel 2 from being lifted up as the female threads 5a on the cap 5 are engaged with the underside of the male threads 2a on the vessel 2 to ~~proceed~~further the threadable engagement.